

Starved Rock Lock and Dam
Illinois Waterway
Illinois Waterway River Mile 231
Vicinity of Peru
La Salle County
Illinois

HAER No. IL-127

HAER
ILL
50-PERU.V,
1-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Department of the Interior
Denver, Colorado 80225-0287

HISTORIC AMERICAN ENGINEERING RECORD
STARVED ROCK LOCK AND DAM

HAER No. IL-1271-

HAER
ILL
50-PERU.V,

Location: Illinois Waterway
Illinois River Mile 231
Peru Vicinity
La Salle County, Illinois

UTM: 16:333750:4576041 (south end of dam)
16:333950:4576570 (north bank)
16:334180:4576360 (east end of lock approach)
16:333619:4576600 (west end of lock approach)
Quad: Starved Rock, Illinois, 1:24,000

Construction Date: 1926-1933

Engineer: Walter M. Smith, Chief Designing Engineer,
Illinois Division of Waterways

Present Owner: United States Corps of Engineers

Present Use: Navigational Lock and Dam

Significance: Starved Rock Lock and Dam consists of a 1,310' straight-crested, reinforced-concrete gravity dam and a 110' x 600' Ohio River Standard lock with horizontally framed miter gates. A 518' headgate section and a 714' controlled spillway make up the dam, which ranges in height from 21' to 31' above the riverbed. Starved Rock is the southernmost facility in the original Illinois Waterway, which linked the Great Lakes to the lower reaches of the Illinois River and ultimately to the Gulf of Mexico. The waterway substantially increased the level of waterborne commercial traffic through the heart of the country.

Project Information
Statement:

The city of Peru, Illinois, applied for a federal permit to build a power plant at Starved Rock Lock and Dam. The facility is a contributing element of the Illinois Waterway, which has been declared eligible for the National Register of Historic Places. The Illinois State Historic Preservation Office determined that the project will have no adverse effect on the property if pre-project conditions are documented for the Historic American Engineering Record. This report fills that requirement.

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INTRODUCTION

Starved Rock Lock and Dam, located on the Illinois River near the small town of Utica in north-central Illinois, is the result of a project to improve the navigational capacity of the river's upper reaches. Formed by the confluence of the Des Plaines and Kankakee Rivers, the Illinois begins about 45 miles southwest of Chicago. It flows southwesterly through the state and meets the Mississippi River at a bend north of Saint Louis. In its more than 270 miles, the Illinois River passes through farmland, as well as through mining and industrial towns.

The river has long been used to transport people and goods. Before the Illinois Waterway improved the route, however, large freight vessels could not navigate the waters above Starved Rock. The Illinois River drops about 47' in the 42 miles from its source to Utica; in the river's remaining 230 miles, the decline is less than 28'. The riverbed's steep declivity above Starved Rock--more than a foot for every mile--coupled with the river's unpredictable flow, made navigation in the unimproved upper portion extremely difficult.

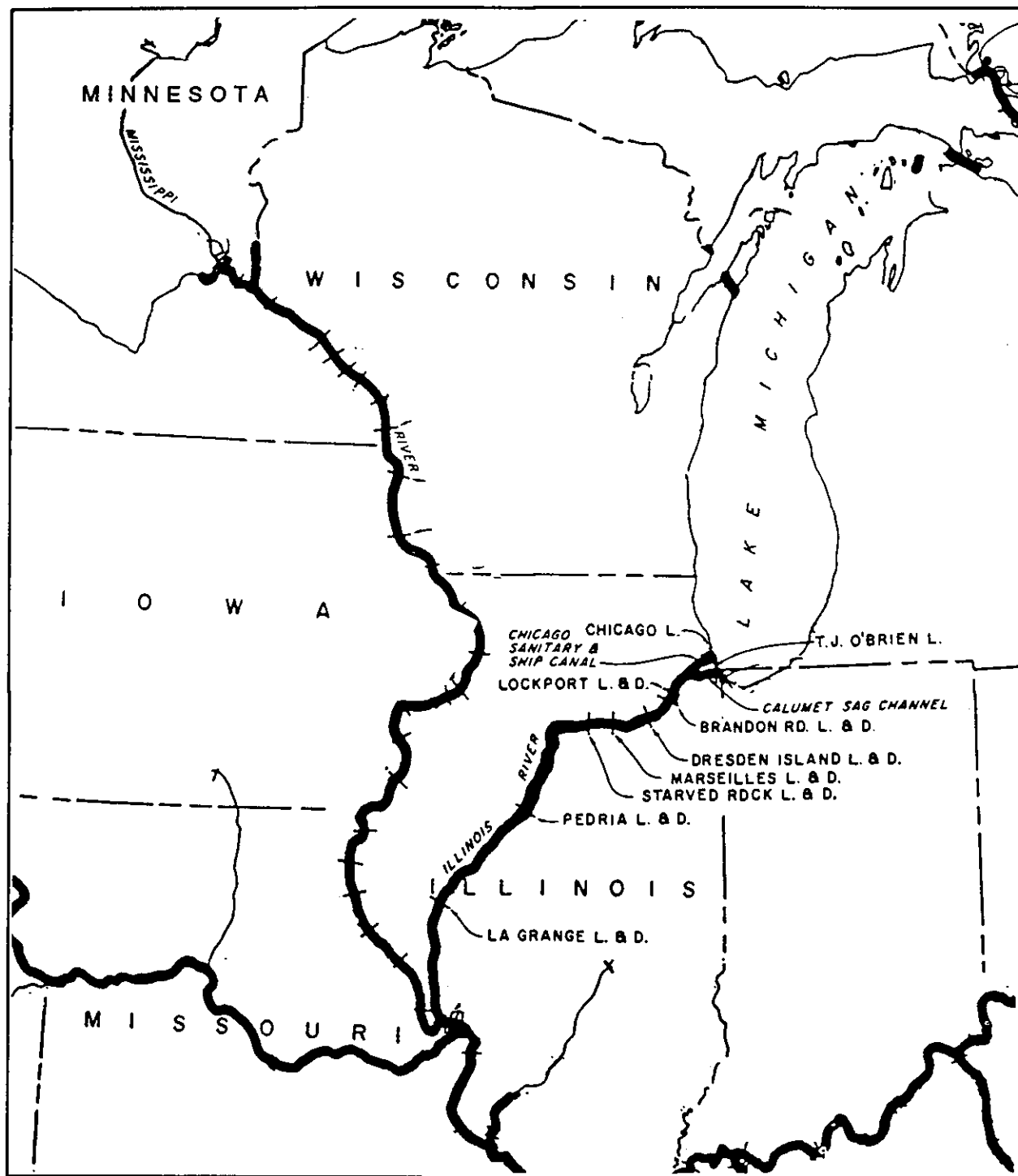
The history of the lock and dam at Starved Rock is inextricably tied to the struggles that surrounded the development of the Illinois Waterway. Four other lock and dam facilities, all located upstream from Starved Rock, make up the remainder of the waterway's original section.¹ The facilities share many traits, since the state standardized plans as much as possible.

Once completed, the waterway opened the river for the first time to freight barges and other larger vessels. In doing so, it completed the final link in a water route for barge traffic from the Great Lakes to the Gulf of Mexico and enabled waterborne commercial transportation to compete with the railroads.

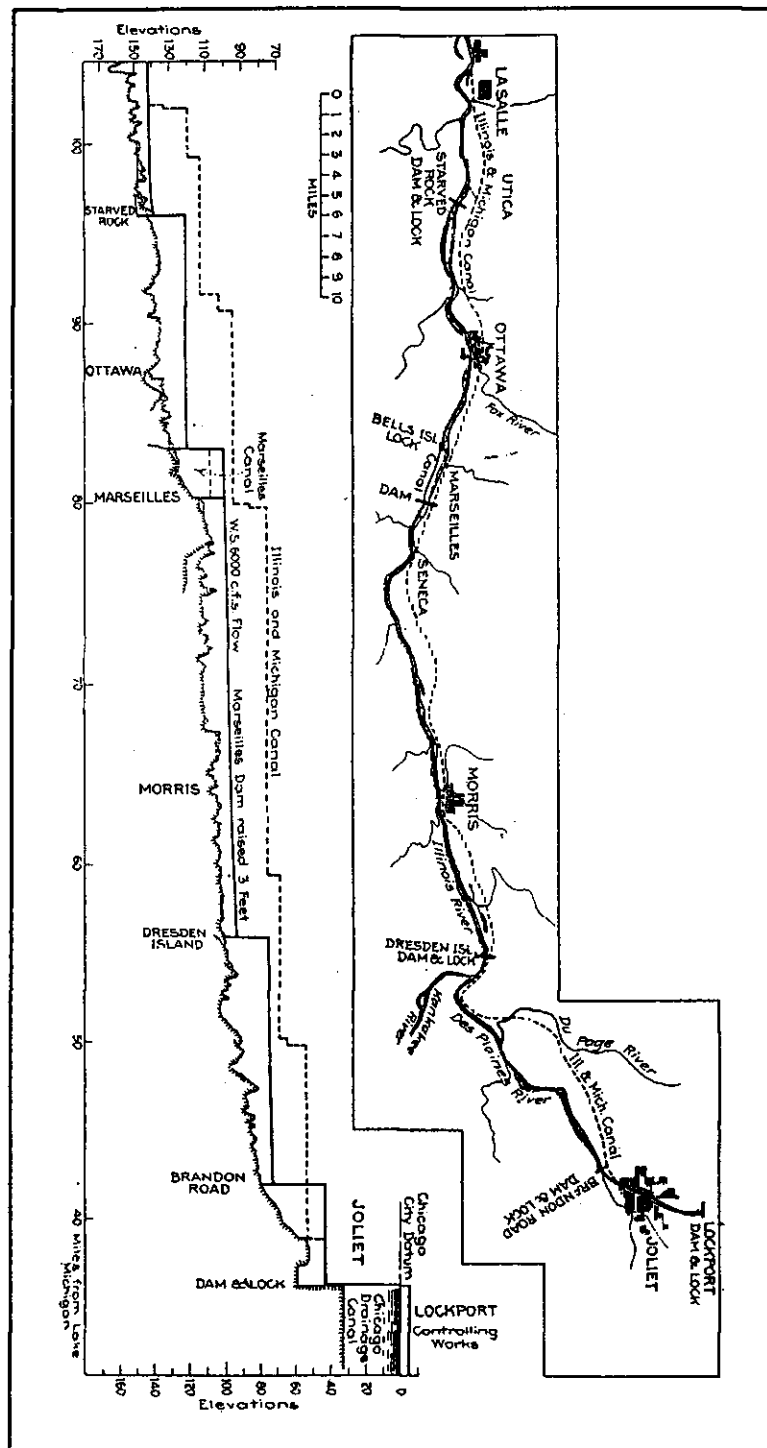
SITE DESCRIPTION

The lock and dam facility at Starved Rock consists of a 110' x 600' Ohio River Standard navigational lock and a 1,310' straight-crested, reinforced-concrete gravity dam. The lock chamber is formed by 38'-high parallel gravity-section walls to the north and south and by horizontally framed miter gates of equal height at the cavity's east and west ends. Filling and emptying culverts for the lock are located in the structure's walls, rather than beneath its floors, as had been current practice. The dam is 33' wide at its base; the crest of the headgate section is 22'-3" wide, and that of the spillway is 50'-6". The structure varies in height from 21' to 34' above its foundation. Two main components make up the dam: a 518' headgate section and a 714' controlled spillway. Vertical-lift gates, 14' x 14', hold

¹ The system was later expanded to include the entire length of the river.



Regional Map. From the U.S. Army Corps of Engineers, *Report on the Upper Mississippi River and Illinois Waterway Navigation System* (Washington, D.C.: General Printing Office, 1989), 5.



The Illinois Waterway. Drawing from "The Illinois State Waterway for Barge Navigation," *Engineering News-Record* 85 (2 December 1920), 1097.

back the river's flow in the headgate section. The spillway is a concrete ogee-curve weir augmented by 19'-high Tainter gates. A concrete apron extends 27' downstream from the spillway to protect the riverbed from erosion.²

The facility stretches across the Illinois River 231 miles above the river's mouth. Utica lies three miles to the north, and the city of Peru stands less than ten miles west. While the river generally follows a southwesterly course, it flows almost due west in this area. High, limestone bluffs--part of the 1,760-acre Starved Rock State Park--line the south bank of the river. County Highway 34 parallels the flat north bank, providing easy access to the lock and dam facility by car.

Due to the westerly flow of the river at this point, the dam runs nearly north-south. Its southern end meets the foot of Lover's Leap, a bluff rising nearly 100' above the river. Just downstream is a higher bluff, the famed Starved Rock, for which the lock and dam are named. The lock is situated at the opposite end of the dam, on the river's more accessible north bank. A long, narrow strip of cleared land, immediately adjacent to the river's north bank, accommodates the buildings and structures needed to operate and maintain the lock and dam.

The lock is perpendicular to the dam. Lock dimensions meet the standard set by an Ohio River improvement project in the 1910s.³ The lock chamber can accommodate a towboat and eight jumbo barges--a configuration possessing a 10,000-ton capacity--in a single locking.⁴ Three horizontally framed miter gates control access to the lock: one service gate at each end of the chamber and a third "emergency" gate above the upper service gate. The third gate is used only when the upper service gate fails or is being repaired.

Each miter gate consists of two leaves, 65' wide and 38' high. The outside edge of each leaf is hinged to a lock wall. When a gate is open, its leaves rest in recessed portions of the approach or lock wall. As the gate closes, the leaves pivot into the channel and meet in the

² Dimensions from a drawing entitled "Starved Rock Dam: General Plan and Sections," dated January 1923. The drawing, referenced as No.42, is kept in the vault at the Corps of Engineers Rock Island District headquarters in Rock Island, Illinois.

³ This standard was also employed for the locks on another major waterway project, the 9-Foot Channel Project on the upper Mississippi River, undertaken in the 1930s. For more information on that project, see Jon Gjerde's "Historical Resources Evaluation: St. Paul District Lock and Dams on the Mississippi River and Two Structures at St. Anthony Falls," prepared for the U.S. Army Corps of Engineers St. Paul District.

⁴ Mortimer Grant Barnes, "The Illinois Waterway," Speech delivered before Illinois Society of Engineers, Springfield, 26 January 1922, collection of Illinois Historical Library, Springfield; U.S. Army Corps of Engineers, *The Illinois Waterway: The Connecting Link between the Great Lakes, St. Lawrence Seaway, and Mississippi River* (Washington: Government Printing Office, 1981), 1.

center of the chamber, forming a chevron pointed upriver. The pressure of the river's flow helps seal the miter joint. The leaves are 7' thick and, when closed, form a walkway across the lock chamber.

Most of the operating gears and machinery are located inside the concrete lock walls. The valves, wells, and intake tunnels that control the chamber's water level are also built into the lock walls and floor. The conduits for filling and emptying the chamber measure 12' in diameter. Vertical-lift gates control the openings, and trash racks prevent debris from entering the lock.

Small, utilitarian sheds stand to the right and left of the upper and lower service gates to shelter the controls and the lock operator. The sheds are slightly larger than 6' square and are constructed of aluminum-sheet siding bolted to a metal frame. The structures have flat roofs with wide, overhanging eaves. Large sliding windows occupy the upper half of the walls, offering nearly unobstructed views. A sliding door provides access. A control panel and chair are the only furnishings.

On the north river bank, a long, low concrete retaining wall edges the upper and lower approaches to the lock chamber. The river side of the upper approach presents boats and barges with circular concrete mooring piers to guide their entry into the chamber and provide temporary anchorage if the lock is occupied. The lock offers about a 18' "step" for boats and barges to negotiate a portion of the upper river's steep drop.⁵ Elevation in the upper pool, which reaches fourteen miles upstream to Marseilles, is maintained at about 459' above sea level. The pool below Starved Rock is generally kept at an elevation of 441'.⁶

The dam, as noted above, runs between the lock on the north bank and Lover's Leap on the south bank. Its two sections--the headgate section and a spillway--each employ a different type of movable gate. The use of different gates in a single dam was slightly unusual at the time it was designed, but it reflects the dual role the structure was intended to play. Vertical-lift gates in the headgate section were selected in anticipation of hydropower development, while the spillway's radial Tainter gates control the depth of the navigational pool.

Comprising 518' of the dam's span, the headgate section lies immediately south of the lock's upper gate. Concrete piers, measuring 3' to 4' in width, support the section's thirty vertical-lift gates. The piers' upstream ends slope outward as they approach the riverbed. Concrete beams span the piers on that side, creating a trash rack that prevents river debris from getting trapped in the gate bays. Between the piers, 14'-wide bays hold two gate panels

⁵ W.C. Weeks, "The Illinois Waterway," *Military Engineer* 24 (May-June 1932): 234.

⁶ Barnes, 21.

each, one panel above the other. A power plant was to stretch across the length of the headgate section, but was never erected. The gates, therefore, have remained in the closed position. Eventually, concrete bulkheads were added to the downstream face of the headgate section to control leakage.

A concrete boiler house, measuring about 18' x 70', sits atop the dam at the southern end of the headgates. Added in 1933, the structure's utilitarian design is ornamented only by a small cornice and wide frieze, which tops the walls, and by concrete quoins finishing the corners. Awning windows, grouped in columns four windows high, allow light to enter on the structure's north side. Doors provide access from the east facade. The building houses a boiler and storage space. The boiler generates steam for the heating system that thaws the contacts between the Tainter gates and piers, facilitating winter operation of the dam. Steam pipes, which emerge from the east facade of the boilerhouse, run along the underside of a steel walkway that spans the spillway length of the dam.

An ice chute separates the dam's headgates from its spillway. The 30'-wide concrete overflow weir allows ice and river debris to pass over the dam. Originally, this space held a submersible steel Tainter gate, which was designed to be lowered into a concrete recess incorporated into the pier. The wedge-shaped gate was controlled hydraulically. When the gate was removed, the recess below it was filled with concrete.

The dam's 714' spillway section consists of ten Tainter gates, each 60' wide and 19' high, which control the depth of the upstream navigational pool. Separated by concrete piers, these radial gates consist of a cylindrical segment attached by arms to the piers. Each gate's curved face holds back water in the upper pool and discards excess flow beneath it. The connecting arms, attached to the concrete piers with pins, extend several feet beyond the piers to support concrete counterbalances. The balances were designed to offset most of the gate's weight, enabling manual operation, but the gates are now controlled electrically. Extra blocks of concrete can be added to the counterbalances as necessary.

The spillway section's piers, anchored by concrete footings to the riverbed, are accessible from the steel walkway that spans the section. The walkway platform replaced an earlier wooden version. Steep, narrow flights of metal stairs descend from the walkway to the upstream ends of each pier, which hold the gate operating machinery. Like their counterparts on the headgate section, the easternmost ends of the concrete piers have pointed breakwaters.

A collection of small brick buildings lines the north bank of the river near the lock. Two of these buildings overlook the chamber: the Lockmaster's House and the Illinois Waterway Visitors Center. Other structures include garages and storage sheds. An east-west access road bisects the area, separating the Lockmaster's House and the Visitors Center from the

remaining buildings. A small parking lot sits across the road from the center, and another narrow parking area is behind the Lockmaster's House.

Built in 1932, the Lockmaster's House contains the communications and master controls for the lock and dam. It is a single-story, cross-gabled building with a raised basement. Red brick laid in English cross bond covers the exterior walls. Four concrete stringcourses circle the building at its base, at the floor level, and at the top and bottom of the large, first-floor windows. The concrete window sills and lintels are integrated into the stringcourses. Small awning windows, which provide ventilation, edge larger, single-pane, fixed-sash windows. Basement windows, at grade level, have been filled with square glass blocks.

The uppermost edges of the gable walls are trimmed with small concrete blocks, and the projecting corners are finished with quoins. A decorative wooden cornice, underscored by a brick frieze, tops the remaining walls. Shingles cover the roof. An interior brick chimney rises in the east gable wall. The south facade displays a plaque honoring Mortimer G. Barnes, who oversaw most of the project's construction as chief engineer of the Illinois Division of Waterways.

Doors on the east and west facades provide access to the building. Poured concrete steps lead up to the doors at the raised first-floor level. The steps are lined on each side with stepped brick walls topped with metal rails. Concrete steps descend to an additional basement-level door on the building's east side.

The Illinois Waterway Visitors Center, home to a small waterway museum, stands just west of the Lockmaster's House. The shed-roofed brick building greets visitors with a single-story front facade, which faces the access road and parking lot to the north. Exaggerated boxed eaves finish the overhanging roof. The simple front facade is dominated by the large boxed eave and by tinted glass doors. Full-length windows, also of single, tinted panes of glass, stand on either side of the central doors. Brick pilasters separate the doorway from the flat exterior wall. A narrow, full-length wooden door, painted a dull brick color to blend with the wall, is situated to the left of the main doorway. Four brown drainpipes are located at the corners and on either side of the central doorway.

Concrete steps with metal railings lead from the sidewalk to the front door. The narrow strip of sloping land between the sidewalk and the building is landscaped with shrubbery, gravel, paving stones, and groundcover. The shrubs obscure an access ramp on the left.

The slant of the roof provides height for a second-story observation deck on the building's south wall. The deck boasts an excellent view of the lock and the downstream face of the dam. Four rectangular brick pillars support the balcony. Below it, shallow concrete steps lead from first-floor double glass doors down to ground level. Tinted glass windows cover most of the south facade on both the upper and lower levels.

Columns of awning windows, stacked nearly the height of the building near each end of the east and west facades, are the only windows on those walls. An exterior wooden staircase allows outdoor access to the viewing balcony on the east side. On the west side, a ramp descends to the basement level.

Across the access road and slightly east of the Lockmaster's House sits the maintenance and shop building, erected around 1981. The building is of stretcher-bond brick on a concrete foundation. It has a hipped, shingle-covered roof with two metal ventilators. The front facade faces south and displays a large garage door with a swinging door on either side. The building's large awning windows have concrete sills and are protected by bars. The east and west facades each host a single window, centered in the walls. Two windows adorn both the north and south walls.

Two older brick buildings stand behind the maintenance and shop building. The two structures are of similar design, and both are used for storage. The larger structure, a two-stall garage that sits northeast of the maintenance building, allows entry through wood-paneled lift doors. Each door has sixteen panels, four of which have been replaced with glass panes. The roof is pyramidal with shingles and roof ridge coverings. Plain fascia boards box the wide eaves. Large, six-over-six, double-hung windows are centered in the east and west facades; two more punctuate the north wall. The brick is laid in stretcher bond. The building sits on a concrete foundation. Two small concrete ramps lead a gravel drive up to the doors.

Several yards to the southeast sits the smaller building, originally called the reel cart house and later known as the fire house. This tiny, windowless structure also has a wooden lift door in its south wall. A small concrete ramp leads to the doorway. The brick is laid in American bond. The pyramidal roof and roof ridges are covered in asphalt shingle, and like the garage, the wide eaves are boxed with plain fascia board.

A tan-colored, corrugated metal paint shed sits back several feet from the access road. The side-gabled structure has a concrete foundation with a door and a two-over-two window in its south facade. The east gable end is taken up almost entirely by oversized double doors. Two-over-two windows are centered in the north and west walls.

DEVELOPMENT OF THE ILLINOIS WATERWAY

Revisions to Illinois' constitution in 1870 banned the use of state funds to construct or repair waterways. This restriction was apparently enacted in response to the "almost insuperable difficulties" that the state had encountered during construction of the Illinois and Michigan Canal (I & M).⁷ Completed in 1848, the I & M joined the Chicago River's south branch with the Illinois River at La Salle, a city situated about one hundred miles southwest of Chicago. Since the Chicago River flowed into Lake Michigan, the canal linked the Illinois River--and subsequently the Mississippi River and the Gulf of Mexico--to the Great Lakes. The idea for such a connection was older than the state itself, having been mentioned by explorers, surveyors, and missionaries who passed through the area in the eighteenth and nineteenth centuries.

From the Chicago River, the canal cut across the "Chicago portage" to connect with the Des Plaines River near the city of Joliet. The I & M made use of that river for about a mile, then formed a separate channel running parallel to the Des Plaines' right bank. The river and the canal continued southward together. Below Joliet, the Des Plaines merged with the Kankakee to form the Illinois River. The canal ended at La Salle, where it emptied into the Illinois. Throughout its course, the I & M channel was 6' deep and boasted fifteen locks, 18' wide and 110' long, that enabled vessels to negotiate the route's 146' fall.

Unlike New York's Erie Canal, financed solely by that state, funding for the Illinois canal was enhanced by modest federal grants. Still, at more than \$6 million, the cost of building the I & M was burdensome. The expenditure appeared justified when, despite frequent low water problems, the I & M turned a profit in its first year of operation. At least one estimate says the canal saved businesses in the state \$180 million in freight costs over its first 37 years.⁸

The I & M enjoyed its peak in usage in the early 1860s. After the Civil War, however, the canal began to lose business. The I & M was hit hard by railroad competition and by the increase in the number of freight vessels larger than the channel's, 18'-width. Before it was forty years old, the canal was approaching obsolescence, and the state knew the channel needed to be enlarged. Profits were no longer sufficient to finance expansion, however, and the 1870 constitution precluded the use of state funds to do so. Instead, Illinois passed legislation, ratified by popular vote in 1882, ceding the I & M to the federal government on the condition that the government expand and forever maintain the canal. Federal engineers,

⁷ Weeks, 231.

⁸ Ernest S. Clowes, *Shipways to the Sea: Our Inland and Coastal Waterways* (Baltimore: The Williams & Wilkins Company, 1929), 26-27; Roald D. Tweet, *History of Transportation on the Upper Mississippi and Illinois Rivers* (Washington, D.C.: General Printing Office, 1983), 62; Weeks, 231.

however, had completed a two-year survey of the Illinois River in 1868 and favored improvement of the river over continued use of the I & M. The government let the state's offer expire unaccepted. By 1889, the Illinois General Assembly also encouraged canalization of the river to a minimum depth of 14'.⁹

In the meantime, Chicago had found another use for the canal. Soon after the I & M opened, the city of Chicago appealed to the General Assembly for permission to discharge sewage into the Des Plaines River by way of the new channel. The rapidly growing city had been disposing of its waste in Lake Michigan, which also served as its water-supply source. The General Assembly approved the drainage plan in 1865.¹⁰ Chicago continued to experience unprecedented population growth. Less than twenty years after the city began dumping into the Des Plaines, so much sewage clogged the canal and the river that the two bodies of water inflicted a severe health risk on anyone living nearby. A heavy rain in 1885 underscored the problem by flooding the Des Plaines River, already swollen with sewage. Filthy flood water poured into Lake Michigan, reaching past the city's intake valves two miles from shore.

Officials from the State Board of Health, accompanied by civil engineer Lyman Edgar Cooley, studied the situation immediately following the flood. Their solution was to have the city build a canal large enough to manage flood waters and to sufficiently dilute its sewage. As an added inducement, the canal could form the beginning of a deep waterway to the Mississippi River and could be designed to produce an impressive amount of waterpower.¹¹

The idea of developing the river as a deep waterway instead of enlarging the 6'-deep I & M was not a novel one. Even before the canal was built, some waterway advocates had made the case for improving the river to a depth that would accommodate lake or ocean-going vessels. Though the canal won in that instance, hopes for a deep waterway were not abandoned. In 1845, even as the I & M was being built, hundreds of delegates were

⁹ Tweet, 62-67; Lyman Edgar Cooley, *The Lakes and Gulf Waterway as related to the Chicago Sanitary Problem* (Chicago: John W. Weston Press, 1891), 5; Illinois Department of Purchases and Construction, Division of Waterways, *Ninth Annual Report, 1925 to 1926* (Springfield, Ill., 1926), 21; Internal Improvement Commission of Illinois, *The Lakes and Gulf Waterway: Message of Governor Deneen and Report by the Internal Improvement Commission of Illinois* (Springfield, Ill.: Phillips Brothers State Printers, 1907), 9.

¹⁰ Robert A. Waller, "The Illinois Waterway from Conception to Completion, 1908-1933," *Journal of the Illinois State Historical Society* 58 (Summer 1972): 125.

¹¹ Internal Improvement Commission, *Lakes and Gulf Waterway*, 12.

attending a river convention in Memphis, Tennessee. Convention delegates declared that public revenue should be used for a deep waterway from Chicago to New Orleans.¹²

Thanks to the public's long-term interest in the waterway, and to Chicago's pressing sanitation needs, Cooley's proposed canal for the city met with a favorable response. Chicago was anxious for a connection to the southern port of New Orleans, and a sewage/ship canal would solve its sanitation woes and possibly provoke action regarding a complete waterway. In 1889, the Illinois General Assembly passed legislation creating the Sanitary District of Chicago. Cooley served as its first chief engineer. The district, which included the city and its surrounding municipalities, began building the canal in 1892. To prevent further contamination of Lake Michigan--and the city's water--engineers permanently reversed the flow of the Chicago River, forcing it to travel away from its mouth at Lake Michigan. The sanitary drainage canal followed the south branch of the Chicago River, paralleling the old I & M to connect with the Des Plaines River a few miles south of Lockport. The project, which cost nearly \$75 million before it was completed, was financed entirely by the district. The Chicago Sanitary and Ship Canal opened in 1900.¹³

According to Isham Randolph, who had become the district's chief engineer in 1893, the drainage canal was designed to accommodate 10,000 cubic feet of water per second (cfs), diverted from Lake Michigan. Randolph maintained that such a flow would effectively dilute the sewage pumped into the canal and would elevate river levels as far south as Saint Louis, providing improved navigation. To ensure proper dilution of sewage, the Illinois Legislature stipulated a minimum diversion level of 3-1/3 cfs per thousand inhabitants of the sanitary district.

Actual diversion levels, however, were contingent upon permits from the War Department's Army Corps of Engineers, since the Chicago River was considered a federal harbor. In 1896, while the sanitary drainage canal was still under construction, the Corps of Engineers limited for the first time the district's diversion of Lake Michigan water. The limit was set at 5,000 cfs. Three years later, the Corps restricted the level to 4,167 cfs, concerned that greater diversions would create a dangerous current in the Chicago River. That level was not enforced, however, and the district continued diverting water at a higher rate while dredging the river to reduce the strength of the current. Meanwhile, the district, joined by

¹² Henry T. Rainey, "Address of Hon. Henry T. Rainey," in *Minutes of the Deep Waterway Convention for the Organization of the Lakes to the Gulf Deep Waterway Association* (Saint Louis: Business Men's League, 1906), 28-29.

¹³ Waller, 125; Weeks, 232; Charles Samuel Deneen, *Governor's Special Message to the General Assembly* (Springfield, n.p.: 1911), available in the Charles Samuel Deneen Papers, Illinois Historical Library, Springfield; "Opening of the Chicago Drainage Canal," *Engineering News and American Railway Journal* 43 (11 January 1900): 22; W.G. Gude, "Illinois Waterway Now Completed," *Marine Review* 65 (June 1933): 19.

many deep waterway advocates, continued to press for even greater diversion levels, campaigning for reversal of the eastward-flowing Calumet River.¹⁴

Although Chicago's new drainage canal offered an impressive freight capacity, it could not revive traffic on the I & M. In fact, canal systems were falling out of favor throughout the Midwest. Most canals were too shallow and narrow to accommodate the same loads that trains could handle: canal boats could haul only two hundred tons of freight, while a train could easily manage ten times that amount.¹⁵ Furthermore, while the Chicago Sanitary District had built a canal large enough for barges hauling more than two hundred tons, the steep drop and shallow reaches of the Illinois River would not accommodate those vessels as they traveled downstream beyond Lockport. Traffic using the Sanitary and Ship Canal would be forced to use the deteriorating, comparatively tiny I & M upon passing Lockport.

Ultimately, the massive popularity of the railroad actually helped renew interest in waterway transportation. The early years of the twentieth century saw the volume of business on the rails double, and the demands of freight soon became too much for the railroads to meet alone. Railroad companies responded as best they could, increasing freight car sizes and laying more miles of track, but the demand was still more than they could handle. The cost of laying enough track to relieve the crisis was prohibitive. So desperate was the situation that railroad magnate James J. Hill welcomed waterway competition, telling the House of Representatives that "railroads everywhere are taxed beyond their power. . . . A fifteen-foot canal or channel from Saint Louis to New Orleans would go further to relieve the entire Middle West and Southwest than any other work that could be undertaken."¹⁶

Publicity regarding progress made on the Panama Canal also revitalized plans for a deep waterway from Chicago to New Orleans. Measuring 110' x 1000', the locks in the Panama Canal promised to dwarf those on all other water routes. After visiting the massive project, still under construction, President Theodore Roosevelt heartily endorsed waterway development at the 1907 Lakes-to-the-Gulf Deep Waterway Convention. "Facility of cheap transportation," Roosevelt told the delegates, "is an essential in our modern civilization, and we cannot afford any longer to neglect the great highways which nature has provided for us.

¹⁴ Louis P. Cain, "Unfouling the Public's Nest: Chicago's Sanitary Diversion of Lake Michigan Water," *Technology and Culture* 15 (October 1974): 598-599; Isham Randolph, "The Reopening of the Gateway from the Lakes to the Gulf," in *Report of the Second Annual Convention of the Lakes to the Gulf Deep Waterway Association* (Saint Louis: The Association, 1907), 65-67; Bruce Barker, "Lake Diversion at Chicago," *Journal of International Law* 18 (January 1986): 208.

¹⁵ Deneen, *Special Message*, 4.

¹⁶ "The Deep Water Route from Chicago to the Gulf," *National Geographic Magazine* 18 (October 1907): 680.

. . . It is of national importance to develop these streams as highways to the fullest extent which is genuinely profitable."¹⁷

The federal government had taken a step towards improving the Illinois River in 1902, appropriating \$200,000 to make surveys and to develop plans and cost estimates for a 14' waterway with locks and dams. The resulting plan, developed by army engineers in 1905, included nine locks, 80' wide and 600' long, between Lockport and Utica.¹⁸ The federal government did not, however, appropriate money to construct such a channel, despite strong waterway support from Mississippi Valley congressmen like Democrat Henry T. Rainey of Illinois.

Rainey was elected to the U. S. House of Representatives in 1902 by a district on the lower reaches of the Illinois River. His first speech on the House floor pointed out that the Panama Canal had always been viewed as the completion of the so-called "Lakes to the Gulf Waterway." "It is the duty of every citizen," Rainey proclaimed, "to . . . assist in bringing about the completion of the isthmian canal and 'the Lakes to the Gulf' waterway, which go hand in hand."¹⁹

True to his word, Rainey undertook a trip down the proposed waterway route in November 1905 to drum up publicity and to prove to the Corps of Engineers that a deep waterway between Chicago and New Orleans was possible. Rainey documented the month-long trip with extensive photographs. Five other congressmen joined him on the 26-foot launch in a bipartisan journey down the Illinois and Mississippi Rivers.²⁰

While Rainey was showing other members of Congress the proposed waterway route, the Illinois General Assembly organized the Internal Improvement Commission, a group charged with investigating the feasibility of a deep waterway. Illinois Governor Charles Deneen, serving his first term, appointed three men to the commission, most notably Isham Randolph. Randolph, with his impressive engineering career, was voted chairman. Prior to directing Chicago's Sanitary and Ship Canal project, Randolph had been one of eight American engineers chosen by then-President Theodore Roosevelt to serve on the Panama Canal's International Board of Engineers. The commission retained Lyman E. Cooley, one of the

¹⁷ Theodore Roosevelt, "Address," in *Report of the Second Annual Convention of the Lakes-to-the-Gulf Deep Waterway Association* (Saint Louis: The Association, 1907), 36.

¹⁸ Internal Improvement Commission, *Lakes and Gulf Waterway*, 40, 48.

¹⁹ Congress, House, Representative Rainey of Illinois speaking on Panama Canal in relation to Lakes-to-Gulf Waterway, 58th Cong., 2nd sess., *Congressional Record* (15 December 1903), vol. 38, pt. 1, 268.

²⁰ Marvin W. Block, "Henry T. Rainey of Illinois," *Journal of the Illinois State Historical Society* 58 (Summer 1972): 145; Waller, 131.

initial proponents of the Chicago canal and the first head of the district's engineering department, as secretary.²¹

Awarded a meager \$7,000 budget, the group could make no original surveys and set out instead to study the available data on waterways. For more than a year, the commissioners reviewed federal, state, and Chicago Sanitary District surveys of, and proposals for, the Illinois River completed in the past several years. They concluded that Illinois, which had more to gain from a waterway connecting the Great Lakes and the Gulf of Mexico than did any other state, should thus take the lead in promoting the waterway. In cutting across Illinois, such a waterway would pass through the "most resourceful section of the Mississippi Valley" and would connect a string of primary markets, including Duluth, Milwaukee, Chicago, Peoria, Quincy, and St. Louis. In addition, the upper river's steep drop lent itself to the development of valuable hydroelectric power. The dams that would be constructed to improve navigation in the river could also be used to exploit its waterpower potential, to Illinois' financial advantage.²²

The 1905 federal study and proposal had not included hydroelectric power development. That report stated, however, that "there will probably be no difficulty in modifying [the plan] so as to conform to such development, if those who are to benefit thereby will cooperate with the government."²³ The state commission strongly endorsed such modification, asserting that "the best treatment [of the river] for waterpower may also be the best treatment for navigation."²⁴ While making sure to include a strong statement subordinating hydroelectric development to the river's improvement for navigation, the commissioners' final report also mentioned that the value of the waterpower could be upwards of \$69 million.

Specifications of the state commission's "modified" plan included fewer slackwater pools in the river than had been suggested in the federal project. Such an arrangement would allow each dam to build a higher head, which would benefit the hydroelectric enterprise and provide a deeper channel for navigation. The commission considered navigational locks 80' wide, as suggested by the 1905 federal engineering report. At 80' x 110', these locks were nearly five times the width of the locks on the I & M. The commissioners also contemplated

²¹ Charles Samuel Deneen, unnamed speech advocating waterway construction, TD, Charles Samuel Deneen Papers, Illinois Historical Library, Springfield; Internal Improvement Commission, *Lakes and Gulf Waterway*, iii-iv.

²² Internal Improvement Commission, *Lakes and Gulf Waterway*, 56-62.

²³ Board of Engineers 1905 report, quoted in Internal Improvement Commission, *Lakes and Gulf Waterway*, 44.

²⁴ Internal Improvement Commission, *Lakes and Gulf Waterway*, 50.

even larger locks, 110' x 600', to match those being built on the Ohio River at the time. Such locks would accommodate barge fleets carrying at least 7,500 tons of cargo.²⁵

Reserving its most progressive idea for the report's final paragraph, the three-member group boldly suggested that the state consider building the waterway. Partly because of the state's constitutional ban, and partly due to the belief that the waterway was of national importance, Illinois had been waiting for the federal government to improve the Illinois River. "There may be hidden wisdom," the commissioners reported to Governor Deneen, "in such self-reliance as has marked the policy of the state of New York, and it may be that the example and influence of two such states will be sufficient to lead the Federal Government into a National waterway policy."²⁶

Governor Deneen, obviously in enthusiastic agreement with Randolph's group, reported the Internal Improvement Commission's findings to the General Assembly in April 1907. The governor urged the assembly to pass legislation that would protect the state's interest in the river's waterpower potential. He also advocated using revenue from the sale of the hydroelectricity to reimburse the state for the cost of a deep waterway.²⁷

Congressman Rainey set to work drafting legislation for the Illinois General Assembly based on the commission's report to Governor Deneen. Needing a technical expert, Rainey enlisted the help of commission secretary Lyman Cooley. Together, they created a resolution that would make it possible, finally, for the state to build its long-awaited deep waterway to the Mississippi River.²⁸

Introduced to the General Assembly in the fall of 1907, the resolution outlined a constitutional amendment that would enable the state to construct a deep waterway in the Illinois without funds from the treasury. The effort would improve the steep upper portion of the river between Lockport and Utica with the construction of locks and dams. Power plants could also be built to take advantage of the river's hydropower potential. Revenue from power sales or plant leasing could be set aside for maintaining or improving the system. Initially, the project would be financed through the sale of not more than \$20 million in bonds. That figure probably resulted from the Illinois Improvement Commission's analysis of the 1905 federal proposal. That study had determined that river improvement from Lockport to the mouth of the Illinois River (at Grafton) would cost \$23.5 million. Assuming

²⁵ Internal Improvement Commission, *Lakes and Gulf Waterway*, 47-51.

²⁶ Ibid., 61-62.

²⁷ Ibid., ii.

²⁸ Waller, 127.

approval by the General Assembly, the amendment would be subject to ratification by the voters of the state. On 16 October 1907, the General Assembly passed the resolution by a unanimous vote in both houses.²⁹

Favorable publicity helped foster strong support from the general public for the amendment. The Chicago Sunday Tribune stated in a 1908 voter's guide that the "inspiring influence . . . [the waterway] will have on the commercial and industrial future of the Illinois and Mississippi Valley is too plain to call for argument."³⁰ Congressman Rainey crisscrossed the state to promote the amendment, delivering 200 speeches illustrated with stereopticon pictures of the proposed route taken on his earlier trips. A 1908 pamphlet published by the Internal Improvement Commission outlined the economics of the "\$20 million bond issue," as it was known. The commission claimed that the waterway would not only complete the link from the lakes to the gulf but would also contribute to the state's income with hydropower revenue and thereby "forever lighten the burden of taxation" upon its citizens. The pamphlet, like the commission's report to the governor, emphasized the value of the river's hydroelectric potential, projecting an annual net earnings of \$2.5 million. Curiously, the 1908 publication proposed erecting locks 80' x 800', instead of matching the larger chambers being built into the Ohio River, as the commission had once considered.³¹

At the general election in November, the voters cast their ballots regarding the constitutional amendment. Nearly 60 percent favored the amendment; only 17 percent opposed it. More voters actually ignored the proposition than voted against it.³²

Despite this success at the polls, the state had a difficult time passing enabling legislation for the waterway. The amendment had simply given the state authority to complete the a project; the challenge now was to design it. Two concepts of the waterway divided opinion in the General Assembly, creating deadlock in the years immediately following passage of the amendment. One version, supported by Governor Deneen and Isham Randolph, provided for a channel 14' deep and for aggressive development of the river's hydroelectric capability. Under this plan, the dams and powerhouses would be constructed first, so that the state could immediately begin earning revenue from the sale of waterpower. The state would use that

²⁹ Isham Randolph, *The Illinois Waterway*, address before the Illinois Senate in Committee of the Whole on Waterways, Forty-sixth General Assembly (Springfield, 1909), 3-5; Internal Improvement Commission, *Lakes and Gulf Waterway*, 40.

³⁰ *Chicago Sunday Tribune*, 1 November 1908.

³¹ Waller, 127; Internal Improvement Commission, *The Twenty Million Dollar Bond Issue* (Springfield, Ill.: 1908). A copy of the pamphlet can be found in the Lawrence Y. Sherman Papers, Illinois Historical Library, Springfield.

³² Randolph, *The Illinois Waterway*, 3.

revenue to repay the \$20 million in bonds. Locks would be built later with the subsequent income. An alternate view, supported by Lyman Cooley and United States Senator-designate William Lorimer of Chicago, called for a 24' canal which could accommodate ocean-going vessels. The deeper canal proposal placed little emphasis on hydroelectricity and required federal funding assistance, since its estimated price tag exceeded \$20 million.³³

Yet another contingent found fault with both these plans, although these opponents lacked a clear vision of their own. They contended that 14' was a depth greater than barges would ever need, while 24' was not deep enough for ocean-going vessels and barely deep enough for lake steamers. "Reduced to the last analysis," one opponent wrote, "the channel is nothing more or less than a barge proposition, and for this purpose nine feet is all that is necessary and all that can be economically used. The cost of a nine foot waterway, as against a fourteen foot, will be as dimes to dollars."³⁴

Other opponents took issue with the river's stated hydroelectric potential. Critics claimed that the Internal Improvement Commission based its hydroelectric revenues on a 14,000 cfs diversion from Lake Michigan (the additional 4,000 cfs coming from the planned Cal-Sag Canal) and a combined head of 88' on the river's four proposed dams. Observing that the Chicago Sanitary District could only legally extract such flow from the lake as was necessary for sanitation, opponents doubted that a 14,000 cfs diversion would ever be possible. In 1912, in fact, the district had permission to divert only 4,167 cfs, though it was generally acknowledged to be diverting 7,000 cfs. In addition, critics lodged the complaint that calculations of the power potential were made incorrectly, pointing out that one dam with an 88' head produces more power than four dams with heads totaling that amount.³⁵

Despite such opposition, political forces continued to push for a waterway bill. Neither the 14' nor the 24' faction, however, was able to get their version of the waterway passed by the General Assembly. The plan that finally won legislative approval was championed by Governor Edward F. Dunne, who was elected in 1912. Dunne endorsed an 8' waterway at a significantly lower cost than the two earlier plans. The new governor contended that greater depths were not presently needed. He reasoned that the waterway could be deepened at any point in the future, if necessary. The 1915 Illinois Waterway Act, which codified Dunne's

³³ Waller, 130; Randolph, *Illinois Waterway*, 6.

³⁴ Howard H. Gross, *A Discussion of the Proposed Deep Waterway* (n.p., 1909). A copy of the pamphlet can be found in the Lawrence Y. Sherman Papers, Illinois Historical Library, Springfield.

³⁵ Ebin J. Ward, *The Illinois Water-Power-Water-Way* (n.p., 1912), 3-6. A copy of the pamphlet can be found in the Charles Samuel Deneen Papers, Illinois Historical Library, Springfield.

plan, called for locks at least 55' wide and 300' long.³⁶ When the governor submitted the plan to the War Department for final approval, however, the hapless project hit another snag. The War Department rejected the proposal, finding the dimensions of the canal and locks unacceptably small. The federal government was, at the time, building a 9' canal in the Ohio River with locks measuring 110' x 600', exactly twice the size of those proposed for the Illinois River.³⁷

A reorganization of the state government in 1917 created the Division of Waterways within the Department of Public Works and Buildings. The new division immediately attacked the stalled waterway project. Frank Orren Lowden, who had won the Illinois governorship the year before, was anxious to see work on the project commence. In perhaps one of his most significant decisions regarding the waterway, Governor Lowden hired Mortimer Grant Barnes as chief engineer of the new division. A civil engineer with more than 20 years of experience, Barnes had served as assistant to the engineer in charge of designing the huge Panama Canal locks. Barnes resigned that post upon completion of preliminary designs to accept a position with New York's Board of Water Supply. In New York, he also served for four years on the Advisory Board of Consulting Engineers for Improvement of State Canals.³⁸

Barnes studied the failed proposals, concluding that the 14' and 24' waterways were indeed too deep, while Dunne's version was too small. Knowing that any plan would ultimately have to meet the approval of the War Department, the Division of Waterways began consultations with U.S. District Engineer Colonel C.S. Riche, in an effort to avoid another aborted proposal. Riche recommended that the state build its waterway project to conform to the so-called "Ohio River standard."³⁹ The 110' x 600' locks had been considered in the Internal Improvement Commission's report to the governor issued ten years earlier, but were later ignored in the \$20 million bond campaign.

Another waterway bill was drafted, based on the suggestions made by Colonel Riche and the state's division engineers. The proposal called for a channel in the waterway at least 8' deep, with a bottom width of 150' or more. Locks were required to measure no less than 110' x 600'. The plan enabled, but did not require, the Department of Public Works and

³⁶ Waller, 131; Illinois General Assembly, *Laws of the State of Illinois enacted by the Forty-ninth General Assembly* (Springfield, Ill.: Illinois State Journal Company, 1915), 21-15.

³⁷ Illinois Division of Waterways, *Ninth Annual Report*, 38.

³⁸ Ibid.; John William Leonard, *Who's Who in Engineering: A Biographical Dictionary of Contemporaries, 1922-1923* (New York: John W. Leonard Corporation, 1922), 103.

³⁹ Illinois Division of Waterways, *Ninth Annual Report*, 38.

Buildings to construct, maintain, and operate power plants on the waterway and to use or lease power developed in the river. The act would also repeal the 1915 act.

The General Assembly passed the bill with a nearly unanimous vote, and it became known as the Illinois Waterway Act of 1919. Another act, passed the same day, established the "Illinois Waterway Fund" and determined how the \$20 million bonds would be issued and paid. Only money received from the sale of bonds could be deposited into this fund. Profits generated by the waterway, including any from hydropower development, were dedicated to the "Illinois Waterway Maintenance Fund." Therefore, if any profits were made from hydroelectric developments, those profits would not be put towards the cost of building the waterway, as had been advocated during the campaign for the 1908 constitutional amendment.⁴⁰

The waterway outlined in the 1919 legislation was submitted to engineers in the War Department and approved on 6 March 1920.⁴¹ That year, Division of Waterways engineers began drawing up plans for canalizing the Illinois River with the one-time allotment of \$20 million. The fact that the budget was based on cost estimates at least eleven years old apparently bothered no one.

Like approval of the waterway itself, building the channel would prove to be no simple task. The scale of the project, its potential effect on localities along the river and further downstream, and the continued debate over diversion levels from Lake Michigan would all contribute to the obstacles the division and the state would face. Often, the division found itself far behind schedule even before contracts were let. Starved Rock was spared none of these hurdles.

STARVED ROCK CONSTRUCTION

Division of Waterways Chief Engineer Barnes hired Walter Mickle Smith as Chief Design Engineer for the waterway project. Smith had worked with Barnes on the Panama Canal project, and, like Barnes, had resigned in 1907 to join the New York Board of Water Supply. The two men had also formed a general hydraulic and construction engineering practice together.⁴²

⁴⁰ Illinois General Assembly, *Laws of the State of Illinois enacted by the Fifty-first General Assembly* (Springfield, Ill.: Illinois State Journal Company, 1919), 977-990.

⁴¹ Illinois Division of Waterways, *Ninth Annual Report*, 38.

⁴² Leonard, 1177.

The 1919 Waterway Act stipulated only the dimensions and general location of the locks and dams; Smith and other design engineers needed to fill in the details. At Starved Rock, as at the other waterway sites, they accomplished this with little innovation. As part of a single system, Starved Rock is similar to its four siblings built upstream, though the particulars of each site account for the individualities of each facility. In the case of Starved Rock, for instance, the dam is situated at the base of Lover's Leap. Because of the rockiness of that bank, the lock was built on the more accessible north bank. This was the reverse of the arrangement preferred in the waterway's planning stages.

The dam at Starved Rock had to fill two distinct roles. Its primary function was to control the depth of the pool between Starved Rock and Marseilles, the nearest upstream dam. For this function, designers investigated three types of gates: sliding Stoney gates, horizontally hinged shutters, and non-submersible radial Tainter gates. Stoney gates consist of panels which slide vertically, allowing excess water to flow beneath the panel. Horizontally hinged shutters are metal panels secured to the river bed on their upstream side. The downstream end of the shutter is raised to restrict the river's flow, and surplus water is discharged above the gate. Tainter gates hold back water with curved panels that rotate about a horizontal axis, passing water beneath the panel. Non-submersible Tainter gates are massive, and extend farther out of the river than either the Stoney gates or the hinged shutters. Division of Waterway engineers selected Tainter gates over the others, however, based on their relative ease of installation and operation. Unlike sliding Stoney gates or horizontally hinged shutters, Tainter gates could be counterbalanced, which minimized the need for heavy operating machinery. Sufficient counterbalancing could even enable manual gate operation.⁴³

Tainter gates were not an unusual choice. Radial gates were used in dams as much as a century before Illinois undertook its river channel improvement. The gates evolved from a common design, known as a "paddle gate," which underwent a series of improvements in the nineteenth century. Jeremiah Burnham Tainter bought the rights to a paddle-gate system developed by Theodore Parker, acquiring a patent for it in 1886.⁴⁴

The same gates were used at the Marseilles, Dresden Island, and Brandon Road dams in the Illinois Waterway, but the Tainter gates installed at Starved Rock in 1929 were the largest yet produced anywhere. They spanned 60' from pier to pier with 19' faces capable of holding back a 17' head.

⁴³ L.D. Cornish and Walter M. Smith, "Engineering Features of the Illinois Waterway," *Technical Papers—Journal of the Western Society of Engineers* 31 (May 1926): 176.

⁴⁴ William Patrick O'Brien, Mary Yeater Rathbun, and Patrick O'Bannon, *Gateways to Commerce* (Denver: National Park Service, Rocky Mountain Region, 1992), 73-81.

The dam's secondary purpose was to create a head of water for a power plant, which was to be built directly on the dam. Vertical sliding gates were selected for this purpose, despite the fact that such gates were more difficult to move than the counterbalanced Tainters. The headgates would not need constant adjusting, as the Tainters did, since the goal was to maintain an efficient head for turbines, not to regulate the river's flow.

Power plants, however, would not prove to be part of the initial waterway construction project. Enthusiastically endorsed in the 1908 constitutional referendum, the powerhouses were quietly dropped from the division's building program. This was apparently due to the growing realization through the 1920s that Lake Michigan diversions were threatened. The 1919 Waterway Act had blessed exploitation of the river's hydropower potential, and the division reported in 1922 that Illinois had negotiated a permit to develop power from the federal Water Power Commission. Though the Division of Waterways encouraged immediate construction of the channel and dams, developing plans for the plants did not seem to be a priority. In the division's fifth annual report, published in 1922, Barnes stated that studies for the design of plants were being made "as time permits."⁴⁵ As late as 1926, however, the plants were still seen as part of the project. In that year, a paper authored by Smith and L. D. Cornish, Assistant Chief Engineer for the division, asserted that "structures to be built [at Starved Rock and two other sites] will consist of a dam, lock and hydroelectric plant combined."⁴⁶

Plans and specifications for the concrete work at Starved Rock were ready by October 1921, and bids were invited that month. Only two were submitted, and both were excessively high. Contractors anticipated that floods in the river would break cofferdams and destroy unfinished work, delaying the job and leaving the firm financially responsible for repairs and lost time. The Illinois River was known for its uneven flow, and floods often bloated the river to five or six times its normal size.⁴⁷ The contractors willing to make bids were forced to incorporate the flood risk into their prices. At \$4 million, the high bid represented 20 percent of the waterway's entire budget.

Unwilling and unable to pay such high prices, the division rejected both bids and changed the job's specifications. The state agreed to cover the cost of lost labor and materials in the

⁴⁵ Illinois Department of Public Works and Buildings, Division of Waterways, *Fifth Annual Report, 1921-1922* (Springfield, Ill.: Illinois State Journal Company, 1922), 64.

⁴⁶ Cornish and Smith, 175.

⁴⁷ Carl O. Sauer, Gilbert H. Cady, and Henry C. Cowles, *Starved Rock State Park and its Environs* (Chicago: The University of Chicago Press, 1918), 7.

event of river floods.⁴⁸ Over the course of the next year, however, the division delayed the invitation of bids on all waterway contracts. Construction on the Marseilles lock continued, but little more than surveying and mapping occurred at other sites. The price of materials was unusually high in 1922, and the division was waiting to see if the inflation would continue. When prices did eventually fall, the state had already lost a year's work. On 30 January 1923, the year initially slated for the waterway's completion, proposals were once again invited for excavation and masonry work at Starved Rock. This time, Illinois Waterway Contract No. 2 received eleven bids, but litigation regarding a condemnation proceeding stalled the contract award. Some time later, Byrne Brothers Construction Company of Chicago, the lowest bidder, was informed that it would be awarded the job. Byrne Brothers, however, failed to appear before the division to sign the contract.⁴⁹

In the meantime, there were problems on another front. The division had submitted plans for the lock and dam at Starved Rock to the nearby city of Ottawa, in accordance with the 1919 act. The city rejected them on the broad grounds that the lock and dam were expected to adversely affect Ottawa's sewage system and public lands. Negotiations began between Chief Engineer Barnes, representing the state, and Ottawa City Engineer W. S. Richmond. After four years of discussion, the state agreed to compensate Ottawa \$30,481 for alterations to the city's sewage system and improvements to affected public lands. A memorandum of agreement to that effect was signed on 19 November 1925, finally clearing the way for construction to commence at the Starved Rock site.⁵⁰

Late in 1925, for the third time, proposals were invited for Contract No. 2 at Starved Rock. The contract was awarded to low bidder Woods Brothers Construction Company of Lincoln, Nebraska. On 18 March 1926, Woods Brothers began excavation of a diversion ditch, thus finally commencing construction on the lock and dam that would connect the unnavigable upper river to its easier reaches downstream.⁵¹

Most of the work at Starved Rock that year was confined to clearing and excavating with draglines and gas shovels. The project's design took advantage of the river's gentle curves and islands. The lock, as well as some of the headgate section, were actually built on land--a portion of the north bank that jutted into the river. The immediate construction area, then, needed only levees to protect the work from high water. Even so, the site flooded during

⁴⁸ Illinois Department of Public Works and Buildings, Division of Waterways, *Fourth Annual Report, 1920-1921* (Springfield, Ill.: Illinois State Journal Company, 1921), 21.

⁴⁹ Illinois Department of Public Works and Buildings, Division of Waterways, *Sixth Annual Report, 1922-1923* (Springfield, Ill.: Illinois State Journal Company, 1923), 12-13.

⁵⁰ Illinois Division of Waterways, *Ninth Annual Report*, 7-11.

⁵¹ *Ibid.*, 67.

excavation the first winter, as expected by the nervous contractors who had refused to bid on the 1921 contract. Frost, rather than high water, caused a breach in the levee at the work site. In cold weather, the part of an earth levee above the waterline freezes, while the lower portions settle. This results in a small hole in the earthen barrier, through which water can seep and cause further erosion. A sudden frost at Starved Rock caused a hole near the north bank of the river large enough to flood the work site within an hour. Waterway Division engineers reported that work was delayed considerably due to frost and high water in winter 1926-1927.⁵²

Meanwhile, the diversion question still loomed large for waterway advocates. Surrounding Lake States felt that the Chicago diversion was responsible for lowering Great Lakes levels, a condition that could adversely affect navigation in the lake system. The cause of diversion opponents was aided by a 1925 Supreme Court decision, which found the Sanitary District's use of Lake Michigan water unauthorized by Congress and therefore illegal. Several Great Lakes states filed suit shortly thereafter to halt the unlawful diversion. Waterway proponents knew that a decrease in the flow of water into the Sanitary and Ship Canal would have a direct effect on the work being done in the Illinois River.

In 1926, Illinois Governor Len Small sent a telegram to President Coolidge to counteract these jabs at diversion allowances. He implored the President to ensure healthy appropriations of water and funding for the Waterway, citing the disadvantage the Midwest had endured since the opening of the Panama Canal in 1914. Small informed Coolidge, who was already in favor of developing inland waterways, that the Illinois River channel would be impassable without a sufficient flow from Lake Michigan. "The proper development of our inland waterways . . . so transcends in importance all consideration of private interests or sectional rivalry," Small wrote, "that I call these fundamental facts to your attention in full confidence that your final decision will be made upon the basis of permanent national welfare and sound public policy."⁵³ Congress failed to legitimize the district's diversion, and the lawsuits dragged on.

Waterway construction continued as well, although pervasive high water levels continued to prohibit steady progress at Starved Rock. Finally, the slow start in 1926 gave way to a very productive year. Work on the lock chamber commenced in March 1927.⁵⁴

⁵² Sutton Van Pelt, "Building a Lock and Dam on the Illinois River," *Engineering News and Record* 102 (16 May 1929): 779-780; Illinois Department of Purchases and Construction, Division of Waterways, *Tenth Annual Report, 1926-1927* (Springfield, Ill.: Illinois State Journal Company, 1927), 51.

⁵³ Illinois Division of Waterways, *Ninth Annual Report*, 11-12.

⁵⁴ Illinois Division of Waterways, *Tenth Annual Report*, 51.

Woods Brothers set up a concrete-mixing plant on the river's north bank, near a railroad track that was used to deliver materials to the site. On platforms 18' above the ground, workers erected two huge bins: one, with a capacity of 100 cubic yards, was designated for aggregate, while the second held 200 barrels of cement. A stiff-leg derrick with a 65' boom hauled aggregate or cement into the proper bin from the stock pile or directly from railroad cars. Once loaded into the bins, materials were delivered in batches through chutes to the concrete mixer situated below. Mixed concrete was then sent to the specific work site via industrial railway trackage laid on cofferdams.⁵⁵ Northern Conveyor Manufacturing Company built a conveyor to Woods Brothers specifications that would assist in hauling concrete to the lock forms. The conveyor unit was a 77' truss frame suspended with cables from a steel hoisting truck. Mounted on industrial car wheels, the unit could be moved along a track laid beside the forms for the lock wall. The conveyor frame was counterbalanced, allowing it to be easily raised to a horizontal position when being transported. The frame also carried a 30-inch belt and supported a gasoline engine to operate the belt. Using this system, Woods Brothers poured 300 to 400 cubic yards of concrete each ten-hour shift.⁵⁶

The conveyor delivered concrete to gravity chutes, which directed the flow into one of two massive steel forms, made by the Blaw Knox Company of Pittsburgh. Each form produced a 30' x 38' section of the lock wall. When one 600'-long lock wall was completed, the forms were moved across the lock chamber on rollers--also specially designed--for use in pouring the opposite wall. Woods Brothers found transporting the 125-ton forms on rollers, a tactic more common in moving houses, less costly and more efficient than dismantling them for relocation. For smaller, irregularly sized portions of the lock chamber, workers poured concrete into paneled wood forms. By July 1927, workers had cast sections of the lock wall and floor, as well as a substantial portion of the headgate piers. The next month, Woods Brothers doubled its crew to hasten the lock's completion, already behind schedule. The increased labor force had nearly finished the chamber by December of that year.⁵⁷

Woods Brothers used similar methods to erect the dam's concrete headgate piers. The section's cofferdam extended from the levee protecting the lock chamber to an island in the middle of the channel. The earthen-filled box coffer was built of sheet piling held together with rods and wales. Industrial railway trackage was laid across the top of the temporary

⁵⁵ Illinois Division of Waterways, *Ninth Annual Report*, 62; Charles M. Coff, "Methods of Construction on the Starved Rock Lock and Dam," *Contractors and Engineers Monthly* 18 (January 1929): 10-11.

⁵⁶ Coff, 7.

⁵⁷ Sutton Van Pelt, 780-781; Illinois Department of Purchases and Construction, Division of Waterways, *Eleventh Annual Report, 1927-1928* (Springfield, Ill.: Illinois State Journal Company, 1928), 87; Coff 8-9.

dam. Cars delivered concrete from the mixing plant to the site, where the concrete was poured into wood forms by way of conveyor. One end of the conveyor was anchored on a berm between the cofferdam and the headgate location. The other end, supported by a tripod, reached toward the forms on a gentle incline. The conveyor, manufactured by the Barber-Green Company, was a standard design operated by a gasoline engine.

The contractor poured concrete in four stages, working from north to south: first, the lock and half of the headgate section; next, the remaining headgates, the ice chute, and three Tainter gate piers; then the middle Tainter gate piers of the spillway section; and, finally, the last spillway piers near the south bank. This arrangement allowed the river to continue flowing through portions of its natural channel during construction.

Workers laid a concrete foundation across the length of the headgate section. The piers, spaced 14' apart, were established on this footing. The headgate piers measured 22'-3" in length and 32' to 45' in height. Every third pier was 4' wide; the remaining ones measured 3'. Vertical gate grooves were recessed on the north and south faces of the structures. The upstream portion of the piers past the grooves were made to slope outward from top to bottom, and the entire headgate section was braced with trash racks fastened to the upstream side. To create the piers' sloped upstream ends, wood forms were put into inclined trusses set on rollers. When a pier was finished, workers moved the forms and trusses--still in one piece--to the site of the next pier.⁵⁸

Pouring the concrete for the ice chute pier was difficult. Since the gate was to be controlled hydraulically, the pier needed to incorporate filling and emptying conduits, similar to those in the lock wall. Construction forms were built in small sections, then assembled at the site. The concrete was poured quickly and continuously, resulting in a monolithic structure 18' wide and about 40' high.⁵⁹

The channel island aided construction by enabling the third section, like the lock, to be built partially on land. Cofferdams upstream and downstream from the island used recycled material from the cofferdam being dismantled to the north. Removing the cofferdam from the completed headgate section minimized obstruction of the river channel, thus reducing the risk of flooding.

For the dam's spillway, Woods Brothers first poured a low concrete footing, which sloped downstream, across the remaining section of riverbed. The piers for the ten Tainter gates were significantly larger than those of the headgate section, measuring 50' in length and about 8' in width. The upstream side of the piers also featured pointed breakwaters.

⁵⁸ Coff, 11; Van Pelt, 778.

⁵⁹ Van Pelt, 781.

The height of the piers precluded the use of conveyors to deliver concrete to the wood forms. Woods Brothers instead used a typical boom plant installation. In this method, a chute projects from a tower on a downward slope. A second, divided chute hangs below the first, suspended from the tower by cables running over a boom. The boom pushes the lower chute away from the tower so that it connects with the first section of chuting. Concrete, once delivered to the base of the tower, is hoisted to the top of the chuting. The entire system can be raised or lowered along the height of the tower.⁶⁰

As summer approached in 1928, Woods Brothers had finished about 75 percent of their work. The lock, headgate section, and ice chute were complete; and the crew was making substantial headway on the Tainter gate piers. Still, despite this progress, the project was one year behind schedule.⁶¹

Illinois Waterway Contract No. 7, for metal work at Starved Rock lock and dam, was let in November 1927. The Independent Bridge Company of Pittsburgh submitted the lowest bid at just under half a million dollars.⁶² Independent Bridge was quite familiar with the waterway project, having submitted a number of bids for various Illinois Waterway contracts. The company was already working at Lockport and Marseilles. Work under the Starved Rock metal contract began in spring 1928, when equipment started arriving at the site.⁶³

The firm had erected the metal plant and delivered all materials to the site by August 1928. Soon after, workers began installing the lock's miter gates. The end posts, girders, and diaphragms were set and bolted together for the north leaf of the upper guard gate when work on the gates was halted in September. Engineers at the Marseilles lock were conducting experiments on the gate pintels--the pins on which the gate pivots--and any resulting design changes would apply to the gates at Starved Rock. The experiments demonstrated that the weight of the gates put too much stress on the Monel metal pintels in the hinges. Monel metal, an alloy of copper and nickel, is known for its strength and resistance to corrosion. Experimentation with the Marseilles gates, however, determined that switching from Monel metal pintels to nickel steel versions would reduce corrosion; and air chambers, by adding buoyancy to the 3,000-pound gates, would relieve stress on the hinges. Air chambers, which had previously been used only in the bottom 15' of the Lockport and

⁶⁰ Coff, 10-12.

⁶¹ Illinois Division of Waterways, *Eleventh Annual Report*, 84-87.

⁶² Ibid.

⁶³ Illinois Department of Purchases and Construction, Division of Waterways, *Twelfth Annual Report, 1928-1929* (Springfield, Ill.: Illinois State Journal Company, 1929), 13; Illinois Division of Waterways, *Eleventh Annual Report*, 87.

Brandon Road lower lock gates, were now to be included in the lock gates at all sites. The chambers were formed by sheathing the lock gates with metal plates, sealing air inside.⁶⁴

In November, before the experiments at Marseilles had yielded any results, a cofferdam break flooded the Starved Rock lock site. High water was the culprit. The current through the chamber was strong enough to warp the only gate leaf that had been installed. Woods Brothers began to build a new cofferdam at the lock's downstream end, but high water and the harsh winter prevented its construction until the following spring. More bad luck befell the site when the new cofferdam broke while being dewatered. Less than two weeks later, before repairs to the cofferdam could be completed, the site flooded a third time. Delays on the lock continued. In the meantime, Woods Brothers had not yet finished the masonry work in the dam's spillway, thus precluding installation of the Tainter gates.⁶⁵

In June 1929, after the high water had subsided, work on the miter gates could finally be resumed. The 1928 flooding, occurring, as it did, just before winter, had held up work on the gates for seven months. The north guard gate, which had been mangled by the current when the cofferdam broke, was straightened; other parts were cleaned and reset. Construction continued on the remaining gates. Independent Bridge built the air chambers into the upper gates in October. December saw the miter gates at Starved Rock completed at last.⁶⁶

The following month, engineers made air tests on each gate. They then tested the weakest gate--the one with the greatest leakage of air--in water and found it to be well within the operational limits determined by Division of Waterway engineers. The other gates were assumed to be in good working order as well. A few months later, seals on all four gates were tightened and reinforced with caulking.⁶⁷

Finally, in September 1929, the southern piers were finished, and the Independent Bridge Company began installing the Tainter gates. Instead of the usual truss-member design, in which two arms connect each end of the gate face to a supporting pier, forming a triangular profile, the waterway engineers chose a hammer-head design. In this version, only one arm stretches between a pier and one end of a gate face, joining the face at a point in the plate's

⁶⁴ Illinois Division of Waterways, *Twelfth Annual Report*, 56; Illinois Division of Waterways, *Fifth Annual Report*, 86; Cornish and Smith, 182.

⁶⁵ Illinois Division of Waterways, *Twelfth Annual Report*, 56, 70-73; Illinois Division of Waterways, *Eleventh Annual Report*, 85;

⁶⁶ Illinois Department of Purchases and Construction, Division of Waterways, *Thirteenth Annual Report, 1929-1930* (Springfield, Ill.: Illinois State Journal Company, 1930), 66.

⁶⁷ *Ibid.*, 67.

lower third. The division selected the hammer-head version based on claims that the earlier version used "redundant" members and therefore employed excess materials.⁶⁸

Installation went smoothly, save for interruptions due to the severe winter weather in December and January. In April 1930, Independent Bridge positioned the Tainters' concrete counterweights. The company put one completed gate into operation as a test, discovering that 5,000 pounds of concrete was needed on the counterbalance to offset the gate's load. By the end of the year, all the operating machinery was installed, and the Tainter gates were finished.⁶⁹

In the meantime, work progressed rapidly at other lock and dam sites, making 1929 by far the most productive year of the waterway's construction. The state, however, was coming to the realization that it would run out of funds before the waterway was complete. The division's twelfth annual report, in attempting to explain the lack of sufficient funds, cited the fact that the \$20,000,000 budget was calculated twelve years before construction began. Construction costs had increased substantially during that time, especially during the war. Allowances could not have been made for such increases because the level of waterway funding had been clearly established in the 1908 constitutional amendment. Another amendment would have been necessary to increase available funds.

Illinois turned to the federal government for a solution. As it had attempted to do with the I & M in the 1880s, the state decided to relinquish the waterway to the War Department's Corps of Engineers. Governor Louis Emmerson began courting the government in summer 1929, taking Secretary of War James Good on an elaborate tour of the still-unfinished waterway. The participants engaged in the usual politicking. Good stated his admiration for the work that Illinois engineers had accomplished, while Emmerson pledged that the waterway would be completed within his term. At the trip's conclusion, a committee was named to discuss the legal and political issues relating to transferring the waterway to the federal government. Senator Charles Deneen and Congressman Henry Rainey, among others, served on the committee, which discussed the matter with the Illinois Attorney General, the attorney for the Chicago Sanitary District, and the U. S. Attorney General.⁷⁰

The following March, Emmerson officially appealed to Patrick Hurley (who had taken over as Secretary of War upon Good's death) to encourage Congress to adopt the waterway and to appropriate sufficient funds for its immediate completion. The Corps of Engineers was dispatched to study the situation. The Corps' Chicago District Engineer determined that the

⁶⁸ Illinois Division of Waterways, *Fifth Annual Report*, 75.

⁶⁹ Illinois Division of Waterways, *Thirteenth Annual Report*, 65-66.

⁷⁰ *Ibid.*, 23-27.

federal government should adopt the incomplete waterway since the Corps was already improving the river from Utica to its mouth at the Mississippi River. The engineer recommended deepening the Illinois Waterway channel to 9' to match the depth planned for the lower Illinois and the Mississippi. Finally, he encouraged the federal government to appropriate \$7.5 million to complete the waterway. Secretary Hurley agreed with these recommendations and presented them to the chairman of the Senate Commerce Committee in April 1930.⁷¹

A provision to accept responsibility for the waterway was included in the federal River and Harbors Bill, which was slated for consideration by Congress that summer. Again, controversy ensued over water diversion from Lake Michigan. The Commerce Committee had, in general terms, authorized such a level as was necessary to accommodate a "commercial waterway." Senator Blaine, of Wisconsin, introduced an amendment that would limit diversion to the 1,500 cfs level cited in a recent Supreme Court case.⁷²

In that decision, the Court ordered the Chicago Sanitary District to halt its illegal diversion of Lake Michigan water. Since the district used the flow to dilute its sewage, the Court allowed a phased reduction of the diversion, with the mandated level to be attained by 1938. The district, in the intervening years, would have to develop sewage treatment plants.⁷³

The diversion issue was not completely settled by the Rivers and Harbors Act, which was passed by Congress in June and signed by President Hoover on 3 July 1930. The act provided explicit Congressional authorization of the use of Lake Michigan water for navigation below Lockport. It limited the diversion, however, to the minimum amount needed to sustain a commercially viable waterway. This would prove to be far less than the 10,000 cfs upon which the Sanitary District had based its plans for many years.⁷⁴ Furthermore, the state had calculated its hydropower revenue estimates on a flow of 14,000 cfs, the anticipated capacities of the Drainage and the Cal-Sag Canals together. The provisions of the act, however, effectively restricted the flow from all sources to 3,200 cfs. Such a low level, while certainly sufficient for a navigable waterway, would never produce the \$2.5 million in hydroelectric revenues that the state had championed.

The impact of the controversy over diversion from Lake Michigan is most often assessed in terms of Chicago's waste treatment facility development. Limits on diversion, however,

⁷¹ Illinois Division of Waterways, *Thirteenth Annual Report*, 23-27.

⁷² *Ottawa (Illinois) Daily Republican Times*, 6 June 1930.

⁷³ Barker, 211.

⁷⁴ Cain, 608-609.

clearly affected the state's waterway plans as well. Although never discussed in depth in any of the Division of Waterways' annual reports, the division at some point realized that the value of the river's waterpower potential was substantially less than had been predicted. This is the most likely reason that the hydropower plants originally planned for the waterway were never built.

In the course of its efforts to transfer the project to the federal government, Illinois officials revealed the hydropower miscalculation to the Corps of Engineers. The Chief of Engineers, Major General Lytle Brown, reported on the issue in a letter to the chair of the Senate Commerce Committee in 1930, just before the transfer. Brown explained that the state's projection "appears to have been based on conditions as they existed in 1908 and on an exaggerated conception of the value of these water powers even under those conditions. Subsequent developments have so modified physical and economic conditions that it is now clear that the value of these water powers is very much less than was originally estimated."⁷⁵ Under terms of the federal takeover, the state surrendered its claim to power rights on the river. In doing so, Illinois admitted that it would not be able to recoup its \$20 million expenditure with hydroelectric profits, as it had promised taxpayers in 1908.

Over \$3 million of that amount had been spent on the lock and dam at Starved Rock by the time the waterway was transferred. Woods Brothers and their subcontractors had finished the work for Contract No. 2--the bulk of the construction expense--just a few months earlier. The Independent Bridge Company had concluded metal work under its contract the month before Hoover signed the bill. All the gates--those on the dam as well as the lock chamber's miter gates--were installed but not yet in operation.⁷⁶ Overall, about 95 percent of the work at Starved Rock was finished, making the lock and dam more complete than any other facility under construction on the river.⁷⁷

The Army Corps took over responsibility for the channel soon after the enabling legislation was signed. Most of the Corps' work at Starved Rock was limited to the buildings planned for the site. Early in 1932, the Corps built the Lockmaster's House on the north bank, just north of the lock chamber. The structure was the lock and dam's control center, housing main controls and communications equipment for the facility. That year also saw erection of machine shelters, establishment of a sewage system, and partial installation of electrical equipment to operate the lock and dam.

⁷⁵ Illinois Division of Waterways, *Thirteenth Annual Report*, 11.

⁷⁶ *Ibid.*, 39-43.

⁷⁷ John W. Larson, *Those Army Engineers: A History of the Chicago District U. S. Army Corps of Engineers* (Washington, D.C.: General Printing Office, 1967), 3-1-3.

On 1 April 1932, the Corps put Starved Rock Lock and Dam into operation. Workers lowered the huge Tainter gates into the river with hand-cranked gears anchored to the gate piers.⁷⁸ When the gates were closed, they raised the elevation of the upper pool to about 455'. They also earned the distinction of the largest Tainter gates in use anywhere. Other facilities upstream were still incomplete, so traffic could only travel up the waterway as far as Marseilles.

Over the next two years, the Corps completed the remaining four locks and three dams that made up the original Illinois Waterway, and engineers continued to dredge the channel to produce the 9' depth stipulated in 1930. At Starved Rock, as at the other facilities, the Corps also built garages, storage sheds, and dwellings for lockkeepers. The two identical keepers' residences at Starved Rock faced each other across a small courtyard, northeast of the Lockmaster's House. The two-and-a-half-story dwellings had hipped roofs with dormer windows. In the center of the courtyard stood the small, windowless, brick reel cart house. A two-stall garage, also brick, with a pyramidal roof was built at the northernmost end of the yard. West of the dwellings, the Corps erected a paint shed and warehouse. In 1933, federal engineers added the boilerhouse to the dam.

On 27 February 1933, the channel between Lockport and Utica was opened to limited navigation. Some bridges across the waterway still needed to be raised or otherwise altered, but smaller vessels could make the trip on the formerly unnavigable section of the Illinois River. On 6 March, the first commercial freight shipment was launched from Ottawa, bound north for Chicago. The Kno-Ma-Se, a 27' motor boat, passed through the four locks upstream from Starved Rock. It averaged about 45 minutes at each lock, some of which were operated manually.⁷⁹

The waterway was officially opened to traffic on 7 June 1933. That year saw over 35,000 tons of freight with a total value of nearly \$400,000 carried over the new waterway. The following year, the tonnage decreased slightly, while the value of goods shipped doubled. In the meantime, use of the old I & M ceased. The state asked Congress to remove its designation as a navigable waterway, since the connection provided by the I & M was no longer needed.⁸⁰

⁷⁸ U.S. Army Corps of Engineers, *Annual Report of the Chief of Engineers, U.S. Army, 1932* (Washington, D.C.: General Printing Office, 1933), 1184-1185.

⁷⁹ *Ottawa (Illinois) Daily Republican Times*, 6 March 1933.

⁸⁰ U.S. Army Corps of Engineers, *Annual Report of the Chief of Engineers, U.S. Army, 1934* (Washington, D.C.: General Printing Office, 1935), 669-670; U.S. Army Corps of Engineers, *Annual Report of the Chief of Engineers, U.S. Army, 1935* (Washington, D.C.: General Printing Office, 1936), 710-713.

As the final lock and dam in the original waterway, the facility at Starved Rock is truly the link between the river's steep upper reaches and the more navigable waters below. The structures near Utica join the staircase created by Illinois and the Corps with the natural highway Theodore Roosevelt praised. Despite the delays, miscalculations, and controversies surrounding the waterway and its construction, the system has proven to be a valuable and much-traveled commercial route.

ALTERATIONS TO STARVED ROCK LOCK AND DAM

Starved Rock, and the rest of the Illinois Waterway, continues to be operated and maintained by the Corps of Engineers. The waterway has been expanded to include the 231 miles below Starved Rock, thereby encompassing the entire Illinois River. In 1980, responsibility for the waterway transferred from the Corps' Chicago office to the Rock Island District.

The system was planned anticipating future alterations. After its troubles with the I & M the state wanted to be certain that the waterway could be easily enlarged. Other than routine maintenance at Starved Rock, however, there have been few alterations to the lock and dam. The most significant work involved two alterations to the dam. The Corps undertook a major rehabilitation of the structure in 1978. At that time, the ice chute was inoperable, and the concrete pier that housed it was badly cracked and eroded. Corps engineers removed the gate and, rather than replace it, filled the recess with concrete and installed a overflow weir instead. In 1982, the headgate section was suffering from a similar malady, and engineers added 3'-thick concrete bulkheads to the downstream side of the vertical-lift gates to control the leakage. The Corps also filled the basement of the boilerhouse with concrete to control leakage resulting from erosion.

Construction and demolition have altered the appearance of the facility's small campus on the north bank. The Visitors Center, with its waterway museum and viewing deck, was built in 1977, and the maintenance and shop building was constructed four years later.⁸¹ At about the same time, the two Lockkeepers' dwellings were demolished.

The city of Peru is currently building a hydroelectric powerhouse to take advantage of the head created by the Starved Rock Dam. The plant is small, relative those envisioned by the Illinois Division of Waterways. It will house four inclined-shaft Kaplan turbine units on the south end of the headgate section. The turbines will produce 42,800 megawatt hours of energy each year, supplying the city of Peru with more than a third of its total energy needs. The plant will also provide power for the operation of the lock and dam.⁸²

⁸¹ This information is based on drawings found in a blueprint file kept in the Lockmaster's House at Starved Rock Lock and Dam.

⁸² Dudley M. Hanson, Corps of Engineers, Rock Island, Illinois, to HABS/HAER, Denver, 9 June 1994, Archival Vault, U.S. Army Corps of Engineers, Rock Island District, Rock Island, Illinois.

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Illinois Waterway construction photographs. Operations Division files. U.S. Army Corps of Engineers, Rock Island District, Rock Island, Illinois.

Starved Rock Lock and Dam construction photographs. Lockmaster's House, Starved Rock Lock and Dam, near Utica, Illinois.

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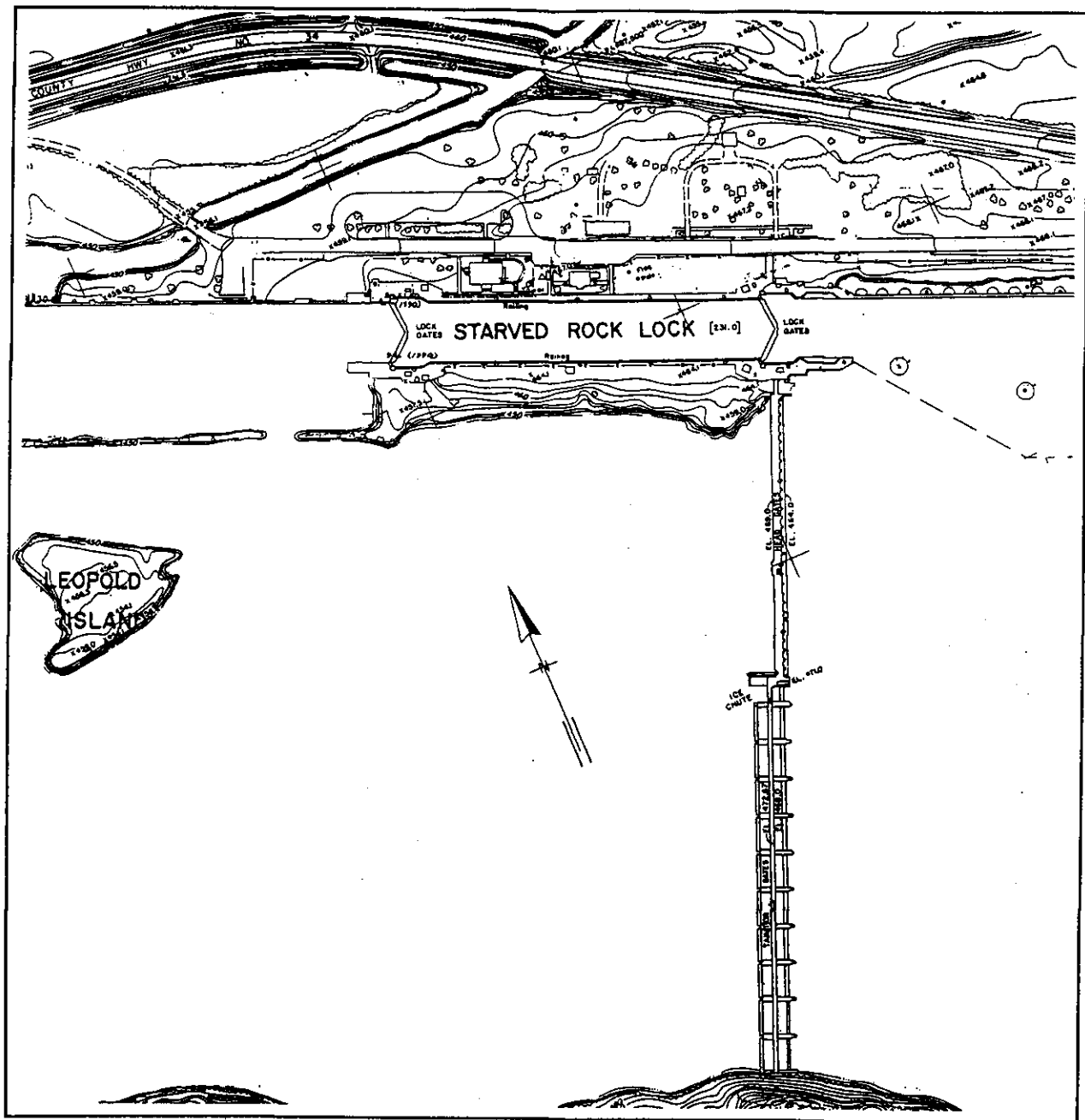
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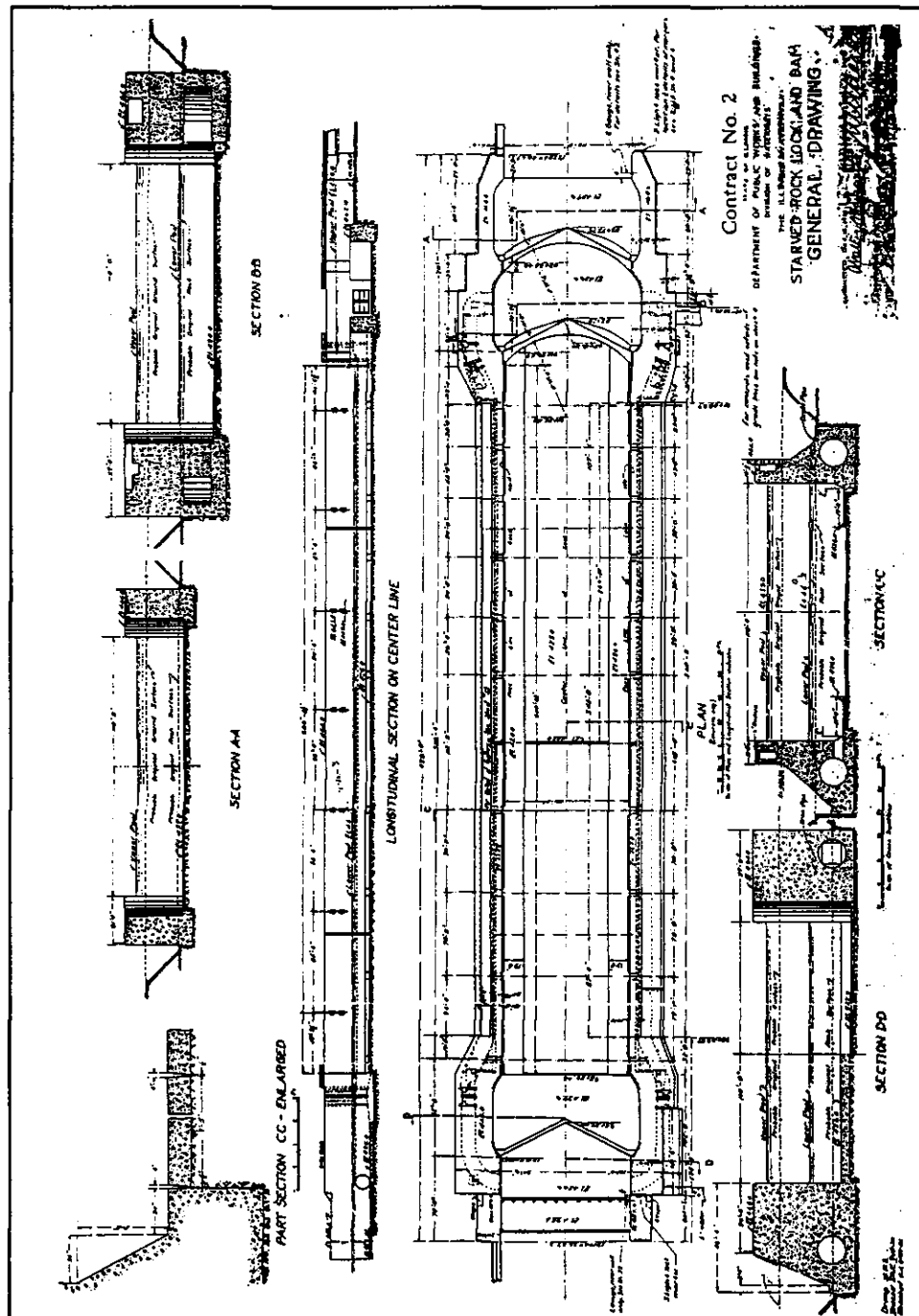
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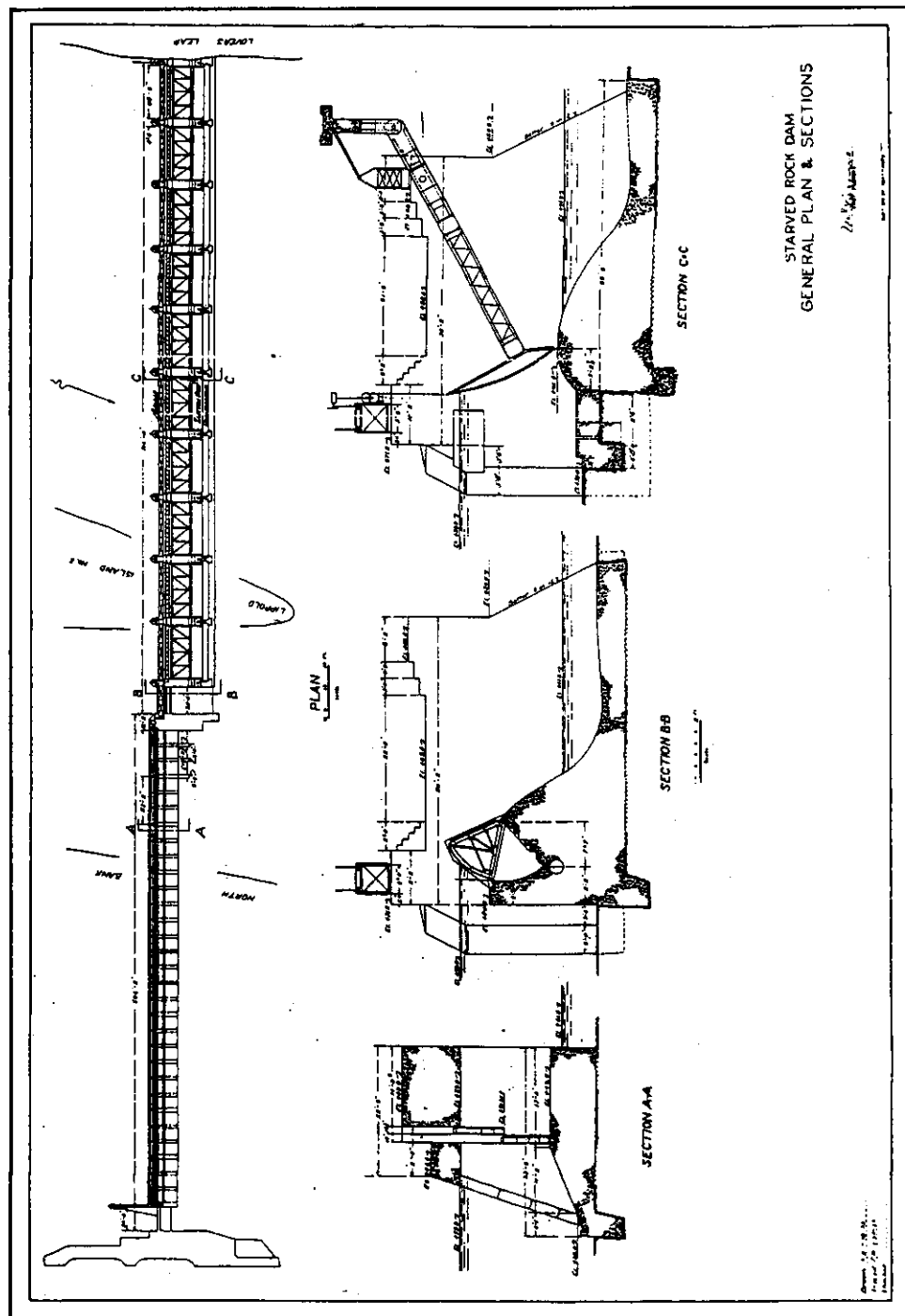
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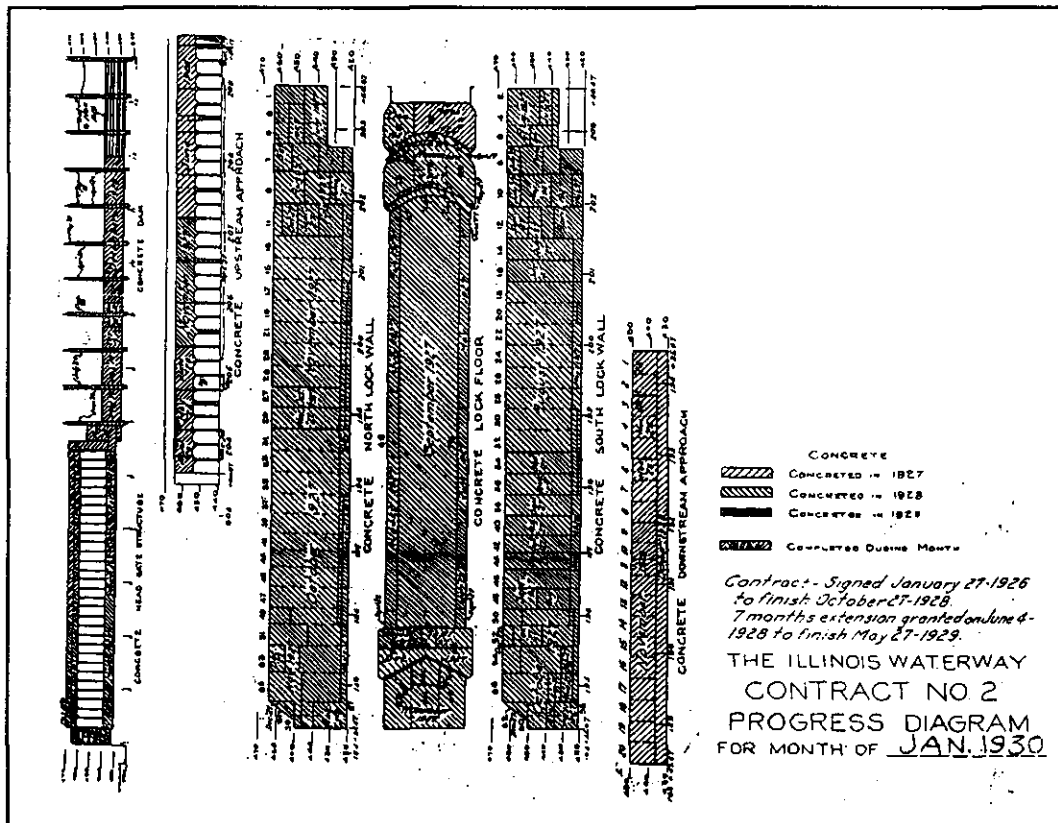
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